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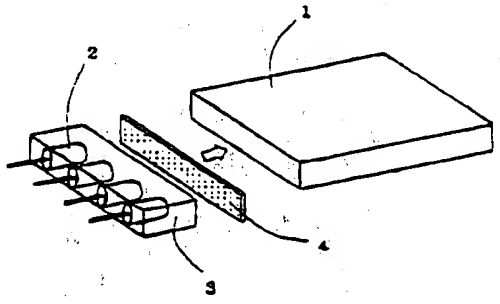
(54)【発明の名称】　面状光源

(57)【要約】
【目的】　ＬＥＤを用いた白色及び任意色の発光が可能な面状光源を提供する。
【構成】　支持体３にＬＥＤランプ２が装着されてなる光源と導光板１とが、前記ＬＥＤランプ２の発光により励起されて蛍光を発する蛍光物質が具備された波長変換体４を介して接合されている。



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【特許請求の範囲】

【請求項1】　支持体3にLEDランプ2が装着されてなる光源と導光板1とが、前記LEDランプ2の発光により励起されて蛍光を発する蛍光物質が具備された波長変換体4を介して接合されていることを特徴とする面状光源。

【請求項2】　支持体3にLEDランプ2が装着されてなる光源と、導光板1とが弾性体を介して接合されてなる面状光源であって、前記弾性体には前記LEDランプ2の発光により励起されて蛍光を発する蛍光物質が具備されていることを特徴とする面状光源。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明はディスプレイのバックライト、照光式操作スイッチ等に使用されるLEDを用いた面状光源に関する。

【0002】

【従来の技術】液晶ディスプレイ等の薄型表示装置のバックライト用面光源として、LEDが注目されている。LEDランプを用いた光源は、導光板の厚さ方向にあたる端面よりLEDランプの光を導入し、面方向で全反射させて面状光源とされる。導光板の厚さは通常2～5ミリ程度と薄く、LEDランプはこの薄い導光板の端面に埋め込まれたり、あるいは支持体等を介して密着させることにより光が導光板に導入される。

【0003】一般に液晶ディスプレイのバックライトの発光色はほとんどが白色とされている。しかし、LEDランプを光源に用いて白色発光を得る場合、三原色のLEDを集合させて、同一平面上に幾何学的に同じ位置に配置しても、バックライトとしてはそれらのLEDを接近した位置で視認するため、均一な白色光源とすることは不可能であった。

【0004】このようなことから我々は、特願平5－318276号で高輝度青色LEDランプを光源に用い発光色の色調を変換することにより白色発光可能なLED面状光源を提案した。この面状光源は、導光板の主面のいずれか一方に、青色LEDの発光により励起されて蛍光を発する蛍光物質と、蛍光を散乱させる白色粉末とが混合された蛍光散乱層を形成し、前記青色LEDの発光の一部を前記蛍光散乱層で波長変換することにより、任意の発光色を得ることができる。

【0005】また我々は、特願平6－134763号では青色LEDランプを光源に用いた面状光源において、導光板の発光観測面に、青色LEDの発光により励起されて蛍光を発する蛍光物質が具備されたフィルムを設けて、発光を波長変換することを提案した。この面状光源は蛍光層が着脱可能なフィルム上に形成されているため、蛍光層が形成されたフィルムを変えるだけで簡単に色調を変化させることができる。

【0006】

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【発明が解決しようとする課題】しかしながら従来の特願平6－134763号に示した面状光源では、蛍光物質が具備されたフィルムを導光板の発光観測面全体に設ける必要があるため、例えば導光板のサイズを大きくした場合、導光板に合わせて蛍光層も大きくしなければならなかった。また、LEDランプ不点灯時でも発光観測面に蛍光層の色が出るため、見栄えが悪く、まぎらわしいという欠点があった。

【0007】上記に示したように青色LEDの発光波長を変換して任意色の発光が可能な面状光源とすることができるが、その他にもLEDを用いて白色を含めた任意色の発光を可能とする面状光源が望まれている。従って、本発明の目的とするところは、上記欠点を解決し、LEDを用いた白色発光可能な面状光源を実現すると共に、均一な白色及び任意色の発光を観測できる面状光源を提供することにあり、さらには信頼性に優れたLEDの特性を利用し、バックライト、各種操作スイッチ等に利用することにある。

【0008】

【課題を解決するための手段】本発明の面状光源は、支持体3にLEDランプ2が装着されてなる光源と導光板1とが、前記LEDランプ2の発光により励起されて蛍光を発する蛍光物質が具備された波長変換体4を介して接合されていることを特徴とする。

【0009】蛍光物質が具備された波長変換体4には、例えばフィルムの表面に蛍光物質が塗布されてなる波長変換シートがあり、この波長変換シートを光源と導光板との接合面の大きさに合わせて切断し、これを介して光源と導光板とを接合させる。また光源からの発光の波長を変換するための蛍光物質としては、蛍光体、蛍光顔料、蛍光染料等がある。これらの蛍光物質は、無機、有機のどちらでも良いが、有機蛍光物質は直流電界により電気泳動を起こし、色調が変化する可能性があるためあまり好ましくない。

【0010】導光板としては、アクリル樹脂、ポリカーボネート等を用いることができる。また支持体としては、白色のポリカーボネート、PBC、ABS等反射効率の良いものであればよい。

【0011】更に本発明の面状光源は、支持体にLEDランプが装着されてなる光源と、導光板とが弾性体を介して接合されてなる面状光源であって、前記弾性体には前記LEDランプの発光により励起されて蛍光を発する蛍光物質が具備されていることを特徴とする。

【0012】我々は特願平7－182543号で、弾性体を介して光源と導光板とを接合する方法を示した。本発明では更に、この弾性体にLEDランプの発光により励起されて蛍光を発する蛍光物質が具備されているため、弾性体を用いて光源からの発光を効率よく導光板に導入でき、しかも弾性体に含有された蛍光物質により光源からの発光を効率的に波長変換することができる。

【００１３】弾性体としては特に限定するものではないが、ＬＥＤランプの発光を透過する樹脂やゴムが用いられ、好ましくはシリコン樹脂、シリコンゴム、アクリルフォーム、あるいは弾性のある基材の両面に接着剤が塗布された両面テープや、接着後も弾性を有する透明な接着剤が用いられる。これらの弾性体に波長を変換するための蛍光物質を具備させるには、例えばシリコン、アクリルフォーム、ＰＥＴ等の基材に練り込んだり、接着剤の中に混入させる等の方法がある。

【００１４】

【作用】光源のＬＥＤランプから出た光は、光源と導光板との接合部から導光板内に導入され、面方向で全反射されて主面側から発光が観測される。本発明の面状光源は図１に示すように、光源と導光板１とが波長変換体４を介して接合されているため、光源のＬＥＤランプ２から出た光の一部は、波長変換体４の蛍光物質により吸収され同時に波長変換されて放射された後、導光板１に導入される。従って、発光観測面側からは、ＬＥＤランプ２の発光と波長変換体４により変換された発光とを合成した色調の発光を観測できる。あるいは、ＬＥＤランプ２からの光を全て波長変換体４により変換すれば、その変換された発光のみの色調を観測することも可能である。更にＬＥＤとして高輝度青色ＬＥＤを用いれば、その発光を蛍光体、蛍光顔料、蛍光染料等の蛍光物質により任意の色調に変換することが可能である。

【００１５】また従来の面状光源では、蛍光物質が具備された蛍光層を導光板の発光観測面全体に設ける必要があったが、本発明の面状光源では光源と導光板の接合面のみに設けるため、波長変換材料である蛍光物質の量を従来よりもかなり少なくできるのでコストが下がるという利点がある。

【００１６】更に、従来の面状光源は、ＬＥＤランプ消灯時でも発光観測面に蛍光物質の色が出ていたが、本発明の面状光源ではこの問題が解消され、消灯時の見栄えが良くなる。

【００１７】また本発明の面状光源は、蛍光物質が具備された弾性体を介して光源と導光板とが接合されているため、弾性体の作用により光源の発光を効率よく導光板に導入することができる。光源と導光板とを接合するには、突き合わせや接着剤による充填接着等の方法があるが、光源や導光板の接合面が平滑鏡面でなく凹凸がある場合、接合面に隙間が生じ、光源と導光板との間に空気の層が出来てしまい、光の導入効率が悪くなっていた。しかしながら、弾性体を介して接合すると、弾性体がクッションの作用をすることにより、光源と導光板１との間にできた隙間を埋めてしまうため空気の層が出来ないので、光源からの発光が効率よく導光板に導入される。また、接着剤による充填接着で接合していた時に問題となっていた接着剤の流れ出し等の接着ミスは起こらず、気泡が混入する恐れもない。



【００１８】

【実施例】本発明の面状光源を実施例に基づき説明する。ただし、以下に示す実施例は、本発明の一実施例を示すものであって、本発明を下記のものに特定するものではない。

【実施例１】図１は本発明の面状光源を示す斜視図である。アクリル板の裏面に拡散パターンをスクリーン印刷した導光板を作製する。続いて、白色ポリカーボネート支持体３に複数個の高輝度青色ＬＥＤランプ２を等間隔で固定して光源を作製する。

【００１９】次に、フィルム表面に蛍光層を形成して波長変換体４を得る。蛍光層は、赤色蛍光顔料（シンロイヒ化学製　ＦＡ－００１）と緑色蛍光顔料（シンロイヒ化学製　ＦＡ－００５）とを等量に混合した蛍光顔料をアクリル系バインダー中に分散したものを塗布して形成した。

【００２０】前記導光板１と光源の支持体とを、図１に示すように波長変換体４を介して接合させて面状光源を得た。この面状光源の青色ＬＥＤランプ２を点灯したところ、導光板１の発光観測面からは白色の面状発光が得られた。

【００２１】【実施例２】実施例１と同様にして、導光板１と光源とを作製する。続いて、接着後も弾性を有する接着剤に黄色発光蛍光体（日亜製　ＮＰ－２０４）を混入させた。次に、実施例１の波長変換体４の代わりに、前記蛍光体が含有された弾性接着剤を用いて導光板１と光源とを接合させて面状光源を得た。この面状光源の青色ＬＥＤランプ２を点灯したところ、導光板１の発光観測面からは黄緑色の面状発光が得られた。

【００２２】

【発明の効果】以上説明したように、本発明の面状光源は光源と導光板とが光源の発光の波長を変換するための蛍光物質を介して接合されているので、ＬＥＤからの発光が蛍光物質により効率的に波長変換される。従って、蛍光物質の種類により白色を含め任意色の発光が可能となる。また、本発明の面状光源では光源と導光板との接合面のみに波長変換体を設けるため、波長変換材料である蛍光物質の量が節約できコストが下がる。

【００２３】更に本発明の面状光源は、蛍光物質が具備された弾性体を介して光源と導光板とが接合されるため、光源からの発光を任意の色に変換できるだけでなく、弾性体の作用により各々の接合面に多少の凹凸があっても光源からの発光を効率よく導光板に導入することができる。

【図面の簡単な説明】

【図１】　本発明の面状光源を示す斜視図。

【符号の説明】

１・・・・導光板

２・・・・ＬＥＤランプ

３・・・・支持体

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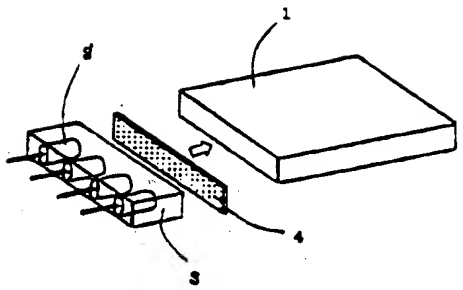
4・・・・波長変換体

6

【図1】



ANNEX 6
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(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

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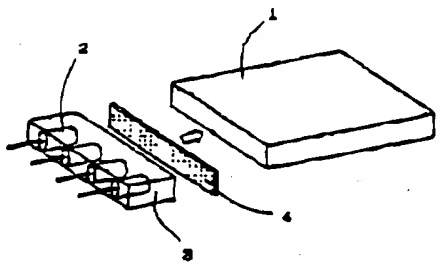
(54) SURFACE LIGHT SOURCE

(57) Abstract:

PROBLEM TO BE SOLVED: To emit white light as well as light of arbitrary color via a light emitting diode by jointing a light source and a light introduction plate via a wavelength converter having a fluorescent material.

SOLUTION: Light emitted from the LED lamp 2 of a light source is introduced to space within a light introduction plate 1 via the joint thereof with the light source, and totally reflected in a planar direction, thereby allowing luminescence to be observed from a principal plane. In this case, the light source and the introduction plate 1 are jointed to each other via a wavelength converter 4 having a fluorescent material. Thus, a part of light emitted from the lamp 2 is absorbed by the fluorescent material of the converter 4 and at the same time, converted in wavelength for emission. Thereafter, the light is introduced to the plate 1. Consequently, the color tone of synthesized luminescence composed of the luminescence of the lamp 2 and luminescence converted with the converter 4 can be observed from a luminescence observation plane. Alternatively, when light from the lamp 2 is all converted with the converter 4, the color tone of only luminescence converted therewith can be observed. Furthermore, when a high intensity blue LED is used as the LED lamp 2, the luminescence thereof including white color can be converted to a desired color tone.





[CLAIMS]

[Claim 1] A sheet-like light source characterized in that a light source comprised of LED lamps 2 attached to a supporting body 3 and a light introducing plate 1 are connected to each other via a wavelength converter 4 comprising fluorescent substances which generate fluorescence by being excited upon irradiation of the LED lamps 2.

[Claim 2] A sheet-like light source which is a sheet-like light source characterized in that a light source comprised of LED lamps 2 attached to a supporting body 3 and a light introducing plate 1 are connected to each other via an elastic body, wherein the elastic body is comprised with fluorescent substances which generate fluorescence by being excited upon irradiation of the LED lamps 2.

[0001]

[Industrial Field of Application] The present invention relates to a sheet-like light source employing LEDs for use as a back light of a display or an operating switch of lighting type.

[0002]

[Prior Art] LEDs are being paid attention to for use as sheet-like light sources such as back lights for thin-type display apparatuses such as liquid crystal displays. A light source employing LED lamps serves as a sheet-like light source by introducing light from the LED lamp from an end surface corresponding to a thickness direction of a light introducing plate and by entirely reflecting the light in a surface direction. The thickness of the light introducing plate is generally small, ranging from 2 to 5 mm, and light is introduced into the light introducing plate by embedding the LED lamps into the end surface of the thin light introducing plate or by closely adhering the lamps via a supporting body or similar.

[0003] Generally, light irradiated as a back light of a liquid crystal display is mostly of

white color. However, though LEDs of three primary colors were forced to be aligned at geometrically identical positions on a same plane for achieving irradiation of white light by employing LED lamps as a light source, an uniform white light source could not be achieved since these LEDs are viewed at a contiguous position when used as a back light.

[0004] In view of the above fact, we have proposed in Japanese Patent Application No. 5-318276 (1993) a LED sheet-like light source capable of irradiating white light by employing high luminance blue light LED lamps as a light source and converting light tones of luminescent colors. This sheet-like light source comprises a fluorescence scattering layer on either of main surfaces of a light introducing plate on which there are mixed fluorescent substances which generate fluorescence by being excited upon irradiation of blue light LEDs and white powder for scattering the fluorescence, wherein irradiation of light of arbitrary colors can be achieved by performing wavelength conversion of a part of the irradiation of the blue light LEDs through the fluorescence scattering layer.

[0005] We have also proposed in Japanese Patent Application No. 6-134763 (1994) to perform wavelength conversion of irradiation with a sheet-like light source employing blue light LED lamps as a light source by forming a film, which comprises fluorescent substances that generate fluorescence by being excited upon irradiation of blue light LEDs, on an irradiation observation surface of a light introducing plate. The provision of a fluorescent layer on an attachable/detachable film in the sheet-like light source enables it to readily change light tones by simply changing a film on which the fluorescent layer is formed.

[0006]

[Problems to be Solved by the Invention] However, in the conventional sheet-like

light source as disclosed in th above Japanese Patent Application 6-134763, the film comprising the fluorescent substances ther on needed to be provided of the entire irradiation observation surface of the light introducing plate, so that in case the size of the light introducing plate was set to be large, the fluorescent layer needed to be made large to suit the light introducing plate. Further, since lights of the fluorescent layer were seen on the irradiation observation surface also in case the LED lamps were switched OFF, drawbacks were presented in that its external appearance was unattractive and also misleading.

[0007] Though it is possible to achieve a sheet-like light source that is capable of irradiating light of arbitrary colors by converting irradiating wavelengths of blue light LEDs, it is being wanted for another sheet-like light source which is capable of irradiating light of arbitrary colors including white by employing LEDs. Thus, it is a purpose of the present invention to provide for a sheet-like light source which is capable of solving the above drawbacks and realizing a sheet-like light source capable of irradiating white light by using LEDs which is a sheet-like light source capable of observing uniform irradiation of light of white and other arbitrary color, and by applying the same for use as a back light or various operating switches by utilizing characteristics of LEDs which are of superior reliability.

[0008]

[Means for Solving the Problems] The sheet-like light source of the present invention is characterized in that a light source comprised of LED lamps 2 attached to a supporting body 3 and a light introducing plate 1 are connected to each other via a wavelength converter 4 comprising fluorescent substances which generate fluorescence by being excited upon irradiation of the LED lamp 2.

[0009] The wavelength converter 4 comprising fluorescent substances may, for

instance, be a wavelength converting sheet which may be arranged by applying fluorescent substances on a surface of a film, and this wavelength converting sheet is cut to suit a size of a connecting surface of the light source and the light introducing plate, whereupon the light source and the light introducing plate are connected with this sheet interposed between. The fluorescent substance for converting wavelengths of irradiation from the light source may be fluorescent bodies, fluorescent pigments or fluorescent dyes. While the fluorescent substance may be either inorganic or organic, organic fluorescent substances are not preferable since light tones are apt to be varied owing to electrophoresis generated through a direct current electric field.

[0010] The light introducing plate may be, e.g. of acrylic resin or polycarbonate. The supporting body may be of a material presenting favorable reflective efficiency such as white polycarbonate, PBC or ABS.

[0011] Another sheet-like light source according to the present invention is a sheet-like light source characterized in that a light source comprised of LED lamps 2 attached to a supporting body 3 and a light introducing plate 1 are connected to each other via an elastic body, wherein the elastic body is comprised with fluorescent substances which generate fluorescence by being excited upon irradiation of the LED lamp 2.

[0012] We have disclosed in Japanese Patent Application No. 7-182543 (1995) a method for connecting a light source and a light introducing plate with an elastic body being interposed between. Since this elastic body is further comprised with fluorescent substance for generating fluorescence by being excited upon irradiation of LED lamps in the present invention, the irradiation from the light source can be efficiently introduced into the light introducing plate by employing this elastic body, and moreover, to effectively perform wavelength conversion of irradiation from the light source by through the fluorescent substances contained in the elastic body.



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[0013] While the elastic body is not especially limited, resin or rubber capable of transmitting irradiation from the LED lamps are used, wherein preferably used items are both-sided tapes applied with adhesive on both surfaces of an elastic base material or clear adhesives presenting elasticity also after adhesion. For making such elastic bodies comprise the fluorescent substances for converting wavelengths, various methods may be taken such as kneading the substances into base materials such as silicon, acrylic foam or PET, or by mixing them into the adhesive.

[0014]

[Action] Light that is irradiated from the LED lamps which comprise the light source in introduced into the light introducing plate from the connecting portion between the light source and the light introducing plate and is entirely reflected in a surface direction so that irradiation is observed from a main surface side. As shown in Fig. 1, the sheet-like light source of the present invention is arranged in that the light source and light introducing plate 1 are connected via the wavelength converter 4, a part of the irradiation that has been irradiated by the LED lamps 2 which comprise the light source is adsorbed by the fluorescent substances of the wavelength converter 4, simultaneously converted in wavelengths and irradiated, whereupon it is introduced into the light introducing plate 1. Thus, it can be observed from the irradiation observing surface side irradiation of light tones obtained by synthesizing irradiation of the LED lamps 2 and irradiation that has been converted through the wavelength converter 4. Alternatively, by converting all of the light from the LED lamps 2 through the wavelength converter 4, it is also possible to observe light tones of converted irradiation only. Moreover, by employing high luminance blue light LEDs, the irradiation may be converted into arbitrary light tones using fluorescent substances such as fluorescent bodies, fluorescent pigments or fluorescent dyes.

[0015] While a fluorescent layer comprising fluorescent substances needed to be provided over an entire irradiation observing surface of a light introducing plate in a conventional sheet-like light source, fluorescent substances are formed only at the connecting surface between the light source and the light introducing plate in the sheet-like light source of the present so that the amount of fluorescent substances which are employed as wavelength converting materials can be remarkably decreased, leading to an advantage that costs may be decreased.

[0016] Moreover, while colors of fluorescent substances were seen on an irradiation observing surface also when LED lamps were switched OFF in a conventional sheet-like light source, this problem could be solved in the sheet-like light source according to the present invention so that an attractive external appearance can be obtained when the lamps are turned OFF.

[0017] Further, since the light source and light introducing plate are connected to each other with the elastic body being interposed between in the sheet-like light source of the present invention, irradiation of the light source can be efficiently introduced into the light introducing plate by the action of the elastic body. While connection of the light source and light introducing plate was performed through methods such as butting or filling adhesion using an adhesive, in case the connecting surface of the light source or that of the light introducing plate was not a smooth specular surface but was formed to be concave or convex, spaces were generated at the connecting surfaces causing airy layers being formed between the light source and the light introducing plate, and thus leading to degradations in introducing efficiencies of light. However, by performing connection with the elastic body being interposed between, the elastic body acts as a cushion which fills spaces that are formed between the light source and the light introducing plate so that airy layers can be prevented and irradiation from the light



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source can be efficiently introduced into the light introducing plate. Additionally, adhesion failures such as leakage of adhesive which were problematic in case connection was performed by filling adhesion using an adhesive can be eliminated and there is neither a fear that bubbles may be intermingled.

[0018]

[Embodiments] The sheet-like light source according to the present invention will now be explained based on embodiments. It should however be noted that the following embodiments are for illustrating examples for embodying the present invention and that the present invention is not limited to the following descriptions.

[Embodiment 1] Fig. 1 is a perspective view showing the sheet-like light source of the present invention. A light introducing plate was manufactured by screen printing a scattering pattern onto a rear surface of an acrylic plate. Thereafter, a light source was manufactured by fixing a plurality of high luminance blue light LED lamps 2 at equal intervals to a white polycarbonate supporting body 3.

[0019] Then. a wavelength converter 4 was formed by forming a fluorescent layer on a film surface. The fluorescent layer was formed by applying a mixture of fluorescent pigments including red fluorescent pigment (FA-001, manufactured by SHINROIHI KAGAKU) and green fluorescent pigment (FA-005, manufactured by SHINROIHI KAGAKU) at equal ratios which was dispersed into an acrylic group binder.

[0020] The sheet-like light source was obtained by connecting the light introducing plate 1 and the supporting body for the light source via the wavelength converter 4 as shown in Fig. 1. By switching the blue LED lamps 2 of the sheet-like light source ON, white sheet-like irradiation could be obtained from an irradiation observing surface of the light introducing plate 1.

[0021] [Embodiment 2] The light introducing plate 1 and light source were

manufactured similarly to those of Embodiment 1. Then, yellow irradiation fluorescent bodies (NP-204, manufacnured by NICHIA) were mixed into an adhesive that presented elasticity also after adhesion. Then, connection of the light introducing plate 1 and the light source was performed by using the elastic adhesive containing the fluorescent bodies therein instead of the wavelength converter 4 of Embodiment 1 to obtain the sheet-like light source. By switching the blue LED lamps 2 of the sheet-like light source ON, yellow-green sheet-like irradiation was achieved from the irradiation observing surface of the light introducing layer 1.

[0022]

[Effects of the Invention] As explained so far, since the light source and the light introducing plate are connected with fluorescent substances for converting wavelengths of irradiation from the light source being interposed between in the sheet-like light source of the present invention, irradiation from the LEDs can be more efficiently converted in wavelengths. Thus, irradiation of light of arbitrary colors including white can is enabled, depending on the type of fluorescent substances used. Further, since the wavelength converter is only formed on the connecting surface between the light source and light introducing plate in the sheet-like light source of the present invention, the amount of fluorescent substances which are the wavelength converting materials can be saved to thereby decrease costs.

[0023] Further, since the light source and the light introducing plate are connected with the elastic body comprising fluorescent substances being interposed between in the sheet-like light source of the present invention, not only can irradiation from the light source be converted into an arbitrary color, but also can the irradiation from the light source be introduced into the light introducing plate in an efficient manner though the respective connecting surfaces may be somewhat concave or concave by the action of

the elastic body.

[Brief Description of the Drawings]

[Fig. 1] A perspective view showing the sheet-like light source according to the present invention.

[Description of Reference Numerals]

1 ... Light introducing plate

2 ... LED lamp

3 ... Supporting body

4 ... Wavelength converter



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